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Mycoflora of the Supraśl river and its tributaries

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In the years (1986-1988) the author investigated of the mycoflora and the effect of environmental factors in the Supraśl River and its 3 tributaries on the occurrence of various aquatic fungi. At the sites investigated the presence of 95 aquatic fungi species was noted. Some new and rare to mycoflora of Poland were found at the investigated sites. The presence of *Truitella setifera*, in the waters is worthy of notice.

Key words: Hydromycoflora, rivers, hydrochemical study.

INTRODUCTION

The knowledge of the mycoflora of Polish running waters is still insufficient. A few reports that have been published on the species composition of fungi include no reference to the chemism of the aqutic environment (S t p i c z y ń s k a - T o b e r, 1965). Thus, all kinds of studies on the aquatic mycoflora with respect to the environment characteristics are essential to elucidate the biology of respective aquatic fungus species.

While carrying out studies of the hydromycoflora in the north-eastern region of Poland, we paid particular attention to various types of running water. These investigations have covered the smaller and the main rivers of this area (C z e c z u g a, 1990, 1991 a, b, 1995 a-c; C z e c z u g a, M u s z y ń s k a, 1993 a; C z e c z u g a, P r ó b a, 1985; C z e c z u g a et al., 1984, 1986 a, b, c, 1988 a, 1990 a, b).

The present paper deals with the occurrence of aquatic fungi with reference to hydrochemical characteristics of different parts of the river Supraśl, a lowland river, and its three main tributaries.

The results of the studies on *Hyphomycetes* in various seasons with reference to environmental conditions of the Supraśl River (C z e c z u g a et al., 1989; C z e c z u g a, O r ł o w s k a, 1993) and chitinophilic fungi of the Płoska River were also published (C z e c z u g a, G o d l e w s k a, 1994).

STUDY AREA

The river Supraśl, 72 km long, the longest right-bank tributary of the middle Narew, rises in rather low hills in the south-east of Zabłudów. It takes the Sokołda waters and flows as far as the mouth of the river Narew via a wide post-glacial valley, continous with the river Narew valley. In this section, the river Supraśl takes some major left-bank tributaries – the rivers Płoska and Biała that carry all kinds of impurities from Białystok.

On the river Supraśl, eleven sites were established, starting from the springs to the mouth (Table 1): 1 – near Mościska, 2 – Michałowo, 3 – Gródek, 4 – Waliły, 5 – where the river Sokołda falls in, 6 – on the beach in Supraśl town, 7 – below Supraśl town, 8 – Wasilków, 9 – Jurowce, 10 – Fasty, 11 – Żółtki, just before it falls into the river Narew.

The Sokołda, a right tributary of the river Supraśl rises in the so-called Sokółka upland, near Racewo village. At the beginning, it flows among fields, later, below Geniusze village, at a level of Janowszczyzna, down to the mouth, it runs through the Knyszyn-Białystok Forest.

The river Sokołda had 7 sites, starting from upper parts of the river to its mouth: 12 – Sokolany, 13 – at a hight of Sokółka, 14 – at a high of Stara Moczalnia, 15 – Międzyrzecze, 16 – Sokołda, 17 – below a dam in Sokołda and 18 – near the mouth to the river Supraśl.

The river Płoska rises in a slight eminence, north-east of Zabłudów, on the southern border of the Knyszyn-Białystok Forest, just in the vicinity of the springs of the river Supraśl. Except a short upper fragment situated among fields, the remainder lies in the valley at its full length, has relatively clean water where trout still can be found.

Three sites were established on the river Płoska: 19 – Zajma (upper part of the river), 20 – Królowy Most (middle part of the river) and 21 – at the mouth to the river Supraśl.

The river Krasna in its upper copurse down to Ciasne village flows through the Knyszyn Forest, in the vicinity of Ciasne among fields and below this village through the Knyszyn-Białystok Forest, exclusively. It flows through a lake called Komosa, through fish ponds in Krasne, and then west of this place falls into the Supraśl as its left tributary. The section below Lake Komosa is sometimes regarded as a separate river called Pilnica.

Eight sites were established on this watercourse. Starting from upper parts downwards these were: 22 – upper river down to Lake Komosa, 23 – southern part of Lake Komosa, 24 – middle part of Lake Komosa, 25 – northern part of Lake Komosa, 26 – between Lake Komosa and a fry pond, 27 – a fish pond, 28 – at the former mill and 29 – near the mouth to the river Supraśl.

Table 1

Morphological characteristics of the investigated rivers

River and No of Site	Length (km)	Catchment area (km^2)	Slope m/km	Mean	
				Width (m)	Depth (m)
Supraśl	93.1	1844.4	0.53		
Site 1				1.2	0.2
Site 2				1.5	0.4
Site 3				2.0	0.5
Site 4				3.5	0.8
Site 5				6.2	1.0
Site 6				6.3	1.0
Site 7				6.6	1.1
Site 8				9.2	1.1
Site 9				12.4	1.2
Site 10				16.5	1.1
Site 11				17.2	1.4
Sokołda	47.2	484.2	0.89		
Site 12				2.3	0.4
Site 13				3.5	0.8
Site 14				4.2	1.0
Site 15				4.8	1.2
Site 16				6.1	1.5
Site 17				8.5	1.7
Site 18				9.0	2.0
Płoska	24.5	215.2	1.35		
Site 19				3.5	0.5
Site 20				4.2	0.7
Site 21				5.0	1.0
Krasna	7.5				
Site 22				1.2	0.3
Site 23 – lake Komosa					0.6
Site 24 – lake Komosa					0.8
Site 25 – lake Komosa					1.2
Site 26				1.4	0.8
Site 27 – pond					1.4
Site 28				3.1	0.7
Site 29				4.2	0.8

MATERIAL AND METHODS

We investigated aquatic fungi in the years 1986-1988. At most sites established there water for the analysis was collected in spring and autumn months, which according to our numerous studies presented the greatest diversity of aquatic fungi. However, in the river Supraśl at the site 6 in the Płoska at the site 21 and in the Krasna at the site 28, samples for fungi and hydrochemical analysis were collected every month in a year-cycle. For determinations of different chemicals in water, the methods recommended by Standard Methods (G o l t e r m a n, C l y m o, 1971) were employed; the details of these methods see in: C z e c z u g a, P r ó b a (1980).

In the water zoosporic fungi were studied by sirect microscopic examination of the water, from materials collected in the water as well as the bait methods (onion skin, hemp-seeds, clover-seeds, hairs and fillings of horn) applied in environmental studies and in the laboratory. The meethods were described in detail in F u l l e r and J a w o r s k i (1986). In addition (for *Hyphomycetes*), the foam collected from the surface of eddies in running water or at the edges of stagnant water was examined directly under a microscope (A r n o l d, 1968). The samples were fixed in formalin--acetic-alcohol immediately after collection andbrough to the laboratory.

For identification of the fungi the following keys word were used: S k i r g i e ł ł o (1954), J o h n s o n (1956), S p a r r o w (1960), S e y m o u r (1970), B a t k o (1975), D u d k a (1974, 1975), I n g o l d (1975) and Ka r l i n g (1977).

RESULTS

H y d r o c h e m i c a l c h a r a c t e r i s t i c s o f t h e r i v e r s. The results of hydrochemical analysis of water are presented in Table 2. Generally speaking, upper parts of these rivers have the cleanest water. In their lower parts, the chemical composition of water deteriorates (except the Płoska) due to municipal sewage pollution. The river Supraśl is polluted by municipal sewage of Supraśl town (site 7) as well as by the sewage of Białystok falling from the river Biała (sites 10, 11). The river Sokołda had the most polluted water at the site 14 due to municipal sewage from Sokółka town. The river Płoska as well as the Krasna present a relatively clean water at their full length. Only at the site 28 of the Krasna in winter months, due to pond draining, the water level in the river Krasna from the site 28 on subsidies considerably, and the sewage drained off from a nearby village affects the water. The one-year-cycle hydrochemical analysis of water in the Supraśl at the site 6, in the Płoska at the site 21 in the Krasna at the site 28 showed oscillations of such parameters as the nitrogen and phosphorus content (Table 3-5).

M y c o f l o r a o f t h e r i v e r s. Ninety-five aquatic fungus species were detected in the waters at the visited sites including 71 zoosporic and 24 conidial fungus (Table 6).

Chemical properties of water particular sites (in mg l^{-1})

No of site (see Table 1) / Specification	1	2	3	4	5	6	7	8	9
Temperature (°C)	9.00	9.00	9.50	9.20	9.40	9.50	9.80	9.60	9.60
pH	7.70	7.70	7.40	7.50	7.40	7.20	7.30	8.10	7.80
Oxidability	9.80	9.40	8.20	16.40	7.20	6.50	16.80	8.80	26.00
CO_2	11.00	11.00	7.70	13.20	9.90	13.20	18.80	11.00	17.60
Alkalinity (mval dm^{-3})	4.10	4.00	3.30	3.70	3.60	3.70	3.70	3.40	3.60
N (NH_3)	0.28	0.22	0.42	0.57	0.07	0.10	1.33	0.44	0.59
N (NO_2)	0.01	0.02	0.31	0.02	0.01	0.01	0.01	0.02	0.03
N (NO_3)	0.03	0.14	1.42	0.11	0.00	0.00	0.00	0.16	0.46
P (PO_4)	0.76	0.58	0.64	2.65	0.55	0.68	1.88	0.87	0.06
S (SO_4)	40.30	48.50	9.05	31.70	18.10	17.70	39.70	33.50	42.80
Cl	25.00	20.00	45.00	26.00	48.00	35.00	39.00	17.00	42.00
Total hardness in Ca	75.60	78.50	49.70	67.00	62.60	62.70	62.60	60.50	47.50
Total hardness in Mg	14.50	14.60	14.20	13.80	14.90	15.90	16.30	11.50	18.50
Fe	0.55	0.45	0.55	0.65	0.15	0.32	0.36	0.25	0.00
Mn			0.08						
Dry residue	415	436	303	388	303	282	311	297	339
Dissolved solids	343	396	235	311	293	277	296	257	290
Suspended solids	72	40	68	77	10	5	15	40	49

cont. Tab. 2

Specification \ No of site (see Table 1)	10	11	12	13	14	15	16	17	18	19
Temperature (°C)	9.70	9.80	9.80	14.70	15.60	15.20	14.00	14.20	13.80	14.00
pH	7.80	7.60	7.40	7.50	7.40	7.80	8.00	7.80	7.50	7.90
Oxidability	20.60	27.20	3.70	5.00	4.90	4.80	4.80	10.50	5.00	5.60
CO_2	19.80	15.40	15.60	4.40	6.80	15.40	13.20	15.40	4.40	8.80
Alkalinity (mval dm^{-3})	4.20	4.70	4.40	4.20	4.60	5.50	4.60	4.20	4.70	3.10
N (NH_3)	3.46	6.58	0.02	0.05	0.09	0.03	0.05	0.35	0.05	0.28
N (NO_2)	0.07	0.14	0.02	0.01	0.03	0.01	0.01	0.01	0.01	0.02
N (NO_3)	0.16	0.00	0.00	0.02	0.02	0.02	0.00	0.68	0.28	0.04
P (PO_4)	3.46	11.24	0.31	0.17	4.65	0.07	0.42	0.06	0.02	0.54
S (SO_4)	38.70	39.60	33.70	30.90	23.50	24.30	24.60	25.50	26.40	36.60
Cl	40.00	96.00	22.00	18.00	23.00	17.00	16.00	31.00	28.20	16.00
Total hardness in Ca	67.70	68.40	70.60	61.90	70.60	87.10	72.00	59.00	41.40	58.30
Total hardness in Mg	13.80	17.60	15.50	17.20	18.10	19.40	16.30	16.80	20.60	8.60
Fe	0.72	0.55	0.25	0.25	0.45	0.00	0.05	0.00	0.00	0.45
Mn			0.15	0.14	0.16	0.00	0.00	0.00	0.00	
Dry residue	402	549	338	309	319	402	266	309	301	280
Dissolved solids	350	421	324	283	315	344	232	255	203	251
Suspended solids	52	128	14	26	4	58	34	54	98	29

cont. Tab. 2

Specification \ No of site (see Table 1)	20	21	22	23	24	25	26	27	28	29
Temperature (°C)	14.20	14.20	15.60	15.00	15.20	15.20	15.20	15.20	15.40	15.40
pH	7.80	8.00	8.10	8.70	8.20	8.40	8.00	8.10	8.20	8.00
Oxidability	7.20	5.80	8.00	7.40	7.20	7.40	8.20	6.20	10.40	6.40
CO_2	8.60	13.20	4.40	0.80	2.40	6.80	4.20	5.20	6.60	5.80
Alkalinity (mval dm^{-3})	3.60	2.80	3.40	2.70	3.00	3.40	3.20	3.20	3.60	3.20
N (NH_3)	0.22	0.04	0.25	0.23	0.30	0.48	0.20	0.18	0.26	0.18
N (NO_2)	0.03	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
N (NO_3)	0.03	0.01	0.09	0.00	0.06	0.08	0.00	0.00	0.02	0.00
P (PO_4)	1.29	1.32	0.17	0.16	0.20	0.21	0.20	0.66	0.84	0.52
S (SO_4)	56.00	24.30	40.70	41.20	41.80	42.20	39.20	38.40	39.40	40.30
Cl	21.00	19.00	14.00	14.00	17.00	18.00	15.00	14.60	13.20	14.00
Total hardness in Ca	61.20	57.60	56.20	49.70	50.40	57.60	50.40	53.20	50.80	50.20
Total hardness in Mg	12.90	13.30	16.30	10.80	11.80	10.60	10.80	11.60	10.80	12.40
Fe	0.25	0.35	0.20	0.32	0.08	0.15	0.20	0.18	0.15	0.08
Mn	0.10		0.12					0.12		
Dry residue	227	258	272	245	268	359	268	312	286	362
Dissolved solids	209	253	257	233	250	348	243	298	266	317
Suspended solids	18	5	15	12	18	11	25	14	20	45

Table 3

Chemical properties of water 6 sites of the river Supraśl in particular months

Specification	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Temperature (°C)	0.50	0.50	1.20	4.60	7.20	8.80	14.80	17.60	9.60	7.00	4.00	2.10
pH	8.00	7.60	7.10	7.90	8.10	8.40	7.90	7.60	7.60	7.50	7.80	7.60
Oxidability	7.70	6.50	7.00	9.20	10.80	7.60	10.40	7.40	7.00	12.80	11.80	6.60
CO_2	8.80	11.00	13.20	11.00	4.40	6.60	6.20	8.80	8.60	19.60	11.00	7.70
Alkalinity (mval dm^{-3})	3.80	4.30	3.90	3.40	3.80	3.60	3.40	4.00	3.90	4.60	3.90	3.90
N (NH_3)	0.29	0.00	0.28	0.28	0.45	0.47	0.52	0.23	0.14	2.82	0.31	0.12
N (NO_2)	0.00	0.01	0.01	0.02	0.03	0.02	0.02	0.01	0.01	2.19	0.02	0.01
N (NO_3)	0.28	0.00	0.01	0.36	0.00	0.12	0.04	0.04	0.02	0.52	0.04	0.00
P (PO_4)	1.52	1.35	0.94	0.87	1.09	2.42	2.08	2.22	1.12	1.67	2.72	0.71
S (SO_4)	25.90	29.20	32.10	23.50	31.30	23.50	21.40	21.80	19.30	39.10	29.20	25.50
Cl	17.00	17.00	17.00	16.00	15.00	13.00	18.00	18.00	18.00	48.00	18.00	21.00
Total hardness in Ca	62.60	59.80	59.20	61.20	61.90	56.20	56.40	61.20	65.50	61.90	59.80	63.40
Total hardness in Mg	11.40	14.60	13.80	9.50	11.20	20.60	13.30	13.80	11.20	20.20	12.00	12.90
Fe	0.32	0.30	0.24	0.55	0.15	0.20	0.55	0.64	0.45	0.52	0.32	0.26
Dry residue	301	370	334	271	299	466	322	340	923	363	314	306
Dissolved solids	254	335	314	266	291	341	269	281	419	323	305	248
Suspended solids	47	35	20	5	8	125	53	59	504	40	9	58

Chemical properties of water 21 sites of the river Płoska in particular months

Specification	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Temperature (°C)	0.50	0.80	1.40	4.80	8.00	9.00	15.10	18.20	11.40	7.20	4.40	2.00
pH	8.00	7.10	6.70	7.60	8.20	8.10	8.10	8.10	7.20	7.40	7.10	7.00
Oxidability	6.80	5.60	17.10	8.40	4.40	7.10	6.50	5.30	6.00	9.40	7.80	6.00
CO_2	20.90	26.40	41.80	26.40	7.70	12.20	17.60	17.80	20.40	16.50	23.10	18.70
Alkalinity (mval dm^{-3})	3.40	3.20	3.00	3.20	3.50	4.10	6.50	5.30	6.00	9.40	7.80	6.00
N (NH_3)	0.85	0.27	0.59	0.95	0.15	0.00	0.00	0.21	1.09	2.95	0.15	0.27
N (NO_2)	0.01	0.01	0.01	0.16	0.16	0.01	0.01	0.02	0.04	0.01	0.01	0.01
N (NO_3)	0.12	0.23	0.32	0.01	0.03	0.03	0.00	0.14	0.06	0.44	0.00	0.08
P (PO_4)	0.41	0.50	0.52	0.07	0.67	0.05	0.29	4.89	1.02	1.01	0.02	0.34
S (SO_4)	31.70	19.70	26.30	23.40	19.70	21.00	30.80	27.20	19.30	25.10	20.50	26.30
Cl	28.00	23.50	30.00	28.50	28.00	17.80	12.50	16.40	8.50	10.40	18.20	22.40
Total hardness in Ca	36.00	62.60	55.40	65.50	69.80	61.90	66.20	63.40	48.20	69.80	72.00	69.80
Total hardness in Mg	12.50	12.40	17.20	10.30	15.10	14.20	13.80	12.50	19.40	11.60	15.50	16.80
Fe	3.10	0.45	0.63	0.55	0.55	0.00	0.00	0.00	0.45	1.24	1.04	1.18
Dry residue	281	330	297	282	232	250	268	218	262	298	287	284
Dissolved solids	271	293	283	265	211	242	241	208	235	279	280	272
Suspended solids	10	37	14	17	21	8	27	10	27	19	7	12

Table 5

Chemical properties of water 28 sites of the river Krasna in particular months

Specification	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Temperature (°C)	0.50	0.50	1.00	4.80	7.80	9.20	15.10	17.80	9.90	7.40	4.20	2.20
pH	8.10	7.80	7.20	8.70	8.10	8.50	8.00	7.50	7.60	7.70	7.80	7.70
Oxidability	6.30	6.80	6.60	9.60	8.40	7.20	13.20	7.00	5.20	17.20	28.00	4.20
CO_2	6.60	8.80	13.20	0.00	4.40	4.20	6.80	8.80	6.60	8.80	8.80	4.60
Alkalinity (mval dm^{-3})	3.70	3.90	3.70	2.60	3.20	3.60	2.80	3.10	3.40	4.00	4.00	3.70
N (NH_3)	0.12	0.00	0.00	0.19	0.75	0.23	0.31	0.31	0.09	0.57	0.33	0.05
N (NO_2)	0.01	0.01	0.01	0.02	0.00	0.01	0.02	0.01	0.00	0.01	0.01	0.01
N (NO_3)	0.12	0.00	0.00	0.06	0.00	0.00	0.08	0.03	0.03	0.00	0.03	0.00
P (PO_4)	1.05	1.10	0.55	0.24	1.29	0.63	1.52	1.14	0.16	1.12	2.65	1.14
S (SO_4)	44.40	43.60	51.80	40.30	39.90	38.30	12.80	33.70	33.30	23.50	38.30	38.30
Cl	15.00	16.000	16.00	13.00	12.00	12.00	16.00	17.00	16.00	15.00	16.00	18.00
Total hardness in Ca	65.50	64.80	61.90	51.80	54.70	33.10	46.10	50.40	56.20	61.20	59.10	63.40
Total hardness in Mg	10.80	13.80	12.10	8.20	12.00	12.10	12.90	12.00	11.20	15.10	16.80	13.30
Fe	0.15	0.00	0.00	0.65	0.65	0.00	0.32	0.45	0.25	0.32	0.35	0.00
Dry residue	245	356	338	268	265	458	266	292	401	373	436	232
Dissolved solids	236	335	325	227	256	284	244	278	389	330	309	231
Suspended solids	9	21	13	41	9	174	22	14	12	43	127	1

Table 6

Aquatic fungi in particular rivers (s – spring, a – autumn)

Species	Site (see Table 1)
Zoosporic	
Achlya americana Humphrey	21s, 28s
Achlya caroliniana Coker	21a
Achlya diffusa Harvey ex Johnson	20s
Achlya dubia Coker	21s
Achlya flagellata Coker	21a
Achlya glomerata Coker	24s
Achlya hypogyna Coker et Pemberton	21s
Achlya klebsiana Pieters	21sa
Achlya megasperma Humphrey	21sa
Achlya oligacantha de Bary	6sa, 21s, 28s
Achlya orion Coker et Couch	21a
Achlya papillosa Humphrey	6s, 8s
Achlya polyandra Hildebrand	2s, 3s, 11s, 20s
Achlya prolifera Nees	21s
Achlya racemosa Hildebrand	28s
Aphanodictyon papilatum Huneycutt	6s
Aphanomyces amphigynus Cutter	6s, 21s
Aphanomyces irregularis Scott	6s, 11sa
Aphanomyces parasiticus Coker	21s
Aphanomyces stellatus de Bary	21s
Aplanes androgynus (Archer) Humphrey	11a
Apodachlya brachynema (Hild.) Pringheim	20a
Asterophlyctis irregularis Karling	21a
Blastocladiella brytanica Horenstein et Cantino	6s
Blastocladiopsis parva (Whiffen) Sparrow	6sa, 21sa, 28s
Catenaria anguillulae Sorokin	6s
Catenaria sphaerocarpa Karling	6a, 21s
Catenophlyctis variabilis (Karling) Karling	21a
Chytridium xylophilum Cornu	5s, 10a, 15s, 18a, 19a, 20a, 21a, 22a, 23a, 28a
Chytriomyces poculatus Willoug. et Townley	21s
Curvularia lunata (Walker) Boedijn	21s
Dictyuchus monosporus Leitgeb	2a, 12s, 13s, 16a, 17s, 18a, 20sa, 21sa, 22a, 28s
Hapalopera fragilariae (Canter) Batko	21s
Hypochytrium catenoides Karling	21s
Isoachlya anisospora (de Bary) Coker	8s, 12a, 19sa, 20sa, 22s, 23sa, 24sa, 25sa, 27sa, 28sa
Isoachlya toruloides Kauf. et Coker	11s, 23sa
Karlingia polonica Hassan	6s, 11s, 12s
Karlingia rosea (de Baryet Woronin) Johanson	21s
Lagenidium humanum Karling	6s
Leptolegnia caudata de Bary	6s
Leptolegniella keratinophila Huneycutt	6s, 21s
Leptolegniella piligena Ookubo et Kabayashi	6a
Leptomitus lacteus (Roth) Agardh	6s, 7sa, 10sa, 11sa, 28s
Myzocytium proliferum Schenk	16a
Nowakowskiella elegans (Nowak.) Schr.	3sa, 11sa, 12s, 14a, 15s, 20a, 28sa
Nowakowskiella macrospora Karling	5sa, 7sa, 8s, 12a, 19a, 21a
Olpidiopsis aphanomycis Cornu	27a
Olpidiopsis saprolegniae (Braun) Coker	9a, 19sa, 25sa, 28sa
Olpidium gregarium (Nowak.) Schroeter	17a

cont. Tab. 6

Species	Site (see Table 1)
Phytophtora megasperma Drechsler	16a
Podochytrium clavatum Pfitzer	25sa
Polychytrium aggregatum Ajello	9a, 12s, 17a, 18s, 19a
Polyphagus euglenae Nowakowski	21s
Pythiogeton nigricans Batko	5a, 6sa, 15a, 19sa
Pythiogeton uniformae Lund	6sa, 28sa
Pythium rostratum Butler	5s, 13a, 22sa
Pythium ultimum Trow	1a, 4a, 16a, 20a, 26sa
Rhizidiomyces bivellatus Nabel	6s
Rhizophidium apiculatum Karling	6a
Rhizophidium carpophilum (Zopf) Fischer	21s
Rhizophidium keratinophilum Karling	6a, 21s
Rhizophidium nodulosum Karling	6a
Rhizophidium piligenum Ookubo et Kobayashi	6s
Rhizophidium pollinis-pini (Braun) Zopf	15s
Rhizophidium verrucosum Cejp	6a, 21a
Rozellopsis inflata (Butler) Karling	1a, 4a, 6sa, 12a, 19sa, 20sa, 21sa, 22a, 29a
Saprolegnia ferax (Gr.) Thurnet	2sa, 3sa, 4sa, 5sa, 6sa, 7sa, 8sa, 9sa, 11sa, 12sa, 13sa, 14sa, 15sa, 16sa, 17sa, 18sa, 19sa, 20sa, 21sa, 23sa, 28sa
Saprolegnia monoica Pringsheim	14a, 28s
Saprolegnia parasitica Coker	21a
Truitella setifera Karling	19a
Zoophagus insidians Sommerstorff	2sa, 7a, 11a, 20a, 23sa, 24a, 29sa
Conidial	
Anguillospora crassa Ingold	27s
Anguillospora gigantea Ranzoni	5s
Anguillospora longissima (Sacar. et Sydov) Ingold	1a, 12a, 13s, 16s, 17a, 21a, 27s, 29a
Anguillospora pseudolongissima Ranzoni	7sa, 8sa, 10s
Apostemidium guernisaci (Cornu) Boud	8sa
Arthrobotrys oligospora Fresenius	11a, 21sa, 26sa
Composporium aquaticum Dudka	18a, 26sa, 27s, 28sa
Candida tropicalis (Castell.) Berkhout	10s, 19s
Dactylaria brochopaga Drechsler	2sa, 11s, 16a, 20a, 29a
Dactyllela submersa (Ingold) Nilsson	21a
Flagellospora stricta Nilsson	6a
Fusarium aquaeductum (Radkl. et Rabh.) Lagh.	7s, 11s, 15s, 19a, 24a
Geniculospora gigantea (Iqbal) Batko	28sa
Geniculospora inflata (Ingold) Nilsson	6s, 21a
Lemmoniera aquatica de Wildeman	1a, 2a, 3s, 12a, 13s, 14a, 16s, 17a, 18s, 19a, 21a, 28s
Mycocentrospora aquatica (Iqbal) Iqbal	18a
Robillarda phragmitis Cunnel	23sa, 25s
Tetracladium marchalianum de Wildeman	9sa, 12s, 13sa, 14a, 18s, 19a, 20a, 21sa, 22a
Tetracladium maxilliformis (Rostrup) Ingold	2sa
Tetracladium setigerum (Grow.) Ingold	12a, 15a, 16a, 17a, 23a, 26a, 28s
Trichophyton mentagrophytes Blanchard	21a
Trichosporon cutaneum (de Beur. et al.) Ota	3sa, 4sa, 6a, 7sa, 11sa, 15a, 19sa
Tricladium angulatum Ingold	13a, 20a, 27a, 28a
Triscelophorus monosporus Ingold	11a, 12a, 14a

Table 7

Hydromycoflora in river Krasna (site 28), Płoska (site 21) and Supraśl (site 6) in particular months

Species	River		
	Krasna	Płoska	Supraśl
Zoosporic			
Achlya americana Humphrey	IX	I	
Achlya caroliniana Coker		IX	
Achlya dubia Coker		V	
Achlya flagellata Coker		XII	
Achlya hypogyna Coker et Pemberton		IV	
Achlya klebsiana Pieters		II, XII	
Achlya megasperma Humphrey		II, IX	
Achlya oligacantha de Bary	IV	V	III-XI
Achlya orion Coker et Couch		X	
Achlya papillosa Humphrey			II
Achlya prolifera Nees		I	
Achlya racemosa Hildebrand	IX	IX	
Aphanodiction papilatum Huneycutt			III
Aphanomyces amphigynus Cutter		IV	III
Aphanomyces irregularis Scott	II, IX	I, II, IV-XII	II
Aphanomyces parasiticus Coker		II	
Aphanomyces stellatus de Bary		II, III	
Apodachlya brachynema (Hild.) Pringsheim		XI	
Asterophlyctis irregularis Karling		XI	
Blastocladiella brytanica Horenstein et Cantino			X
Blastocladiopsis parva (Whiffen) Sparrow	V, VI	V, VI, VIII, X	III, V-XI
Catenaria anguillulae Sorokin			XII
Catenaria sphaerocarpa Karling		III	X
Catenophlyctis variabilis (Karling) Karling		IX	
Chytridium xylophilum Cornu	XI, XII	XI, XII	
Chytriomyces poculatus Willoughby et Townley		IV	
Curvularia lunata (Walker) Boedijn		V	
Dictyuchus monosporus Leitgeb	XI, XII	I-III, VIII	I, II
Hapalopera fragilariae (Canter) Batko		III	
Hypochytrium catenoides Karling		VII	
Isoachlya anisospora (de Bary) Coker	IV, IX	I, VIII, XII	
Karlingia polonica Hassan			I-III
Lagenidium humanum Karling			V-VII
Leptolegnia caudata de Bary			III
Leptolegniella keratinophilla Huneycutt		III	IV

cont. Tab. 7

Species	River		
	Krasna	Płoska	Supraśl
Leptolegniella piligena Ookubo et Kabayashi			IX
Leptomitus lacteus (Roth) Agardh	I, II	I- III, VIII	I
Nowakowskiella elegans (Nowak.) Schr.	I	III, IX	
Nowakowskiella macrospora Karling		XII	
Olpidiopsis saprolegniae (Braun) Cornu	VIII	IX, XI	
Polyphagus euglenae Nowakowski		III	
Polychitrium aggregatum Ajello		IX	
Pythiogeton nigricans Batko		XI, XII	III-XII
Pythiogeton uniforme Lund	VI-VIII		IX, XII
Pythium ultimum Trow		V	
Rhizidiomyces bivellatus Nabel			X
Rhizidium verrucosum Karling			XII
Rhizophydium apiculatum Karling			III
Rhizophydium carpophilum (Zopf) Fisher		IX	
Rhizophydium keratinophilum Karling		VI, VII	X
Rhizophydium nodulosum Karling			IX, X
Rhizophydium piligenum Ookubo et Kobayashi			IV
Rhizophidium verrucosum Cejp		IX	XI
Rozellopsis inflata (Butler) Karling			I, III, VII-XII
Saprolegnia ferax (Gr.) Thurnet	I, III-V, X	V, VIII, IX, XI	III-VI, VIII-XII
Saprolegnia monoica Pringsheim	I-III	XI	
Saprolegnia parasitica Coker		X	
Conidial			
Anguillospora longissima (Sacar. et Sydov) Ingold	II, III, VI		IV-VI, IX-XII
Composporium aquaticum Dudka	V, X-XII		
Dactyllela submersa (Ingold) Nilsson		XII	
Flagellospora stricta Nilsson			I
Fusarium aquaeductum (Radkl. et Rabh.) Lagh.		I	
Geniculospora gigantea (Iqbal) Batko	IV, IX, X		
Geniculospora inflata (Ingold) Nilsson		IV	XI
Lemmoniera aquatica de Wildeman	III		
Tetracladium setigerum (Grow.) Ingold	II		
Trichophyton mentagrophytes Blanchard		IX	
Trichosporon cutaneum (de Beur. et al.) Ota	V, VIII-XI		X
Tricladium angulatum Ingold	X, XI		

In the river Supraśl, the presence of 36 aquatic fungus species, including 12 *Hyphomycetes* was established. At the site 6, where samples were collected at month's intervals for a year, two very rare and one new species to Polish hydromycoflora were found (Table 7). Rare species included *Anguillospora gigantea* and *Flagellospora stricta*, while *Dactylaria brochopaga* was new to Polish hydromycoflora. Worth noting is also the finding of *Leptomitus lacteus* at the sites polluted with municipal sewage (sites 7, 10, 11).

Seasonal occurrence of aquatic fungi the most being found in autumn and spring months, the fewest in summer and winter months (Table 8).

Table 8

Number of species in particular seasons

Season	River		
	Krasna	Płoska	Supraśl
Winter (XII, I, II)*	6.0	7.3	4.0
Spring (III, IV, V)	7.3	6.7	3.7
Summer (VI, VII, VIII)	5.3	4.0	2.0
Autumn (IX, X, XI)	8.7	8.0	5.0

* Samples were collected in third decade of each month

In the Sokołda, 30 aquatic fungus species were detected at 7 sites. Thirteen species were found at the site 12 situated in the very upper fragment of the river. At all sites, *Saprolegnia ferax* was found. The remaining species were observed either at single sites or at a few of them. Such species as *Karlingia polonica, Nowakowskiella elegans, Rozellopsis inflata* and *Isoachlya anisospora* were found only at the site 12, while *Pythium rostratum* and *Tricladium angulatum* were observed at the site 13 exclusively. *Saprolegnia monoica* and *Leptomitus lacteus* were reported from the site 14 and *Rhizophydium pollinis-pini, Pythiogeton nigricans* and *Trichosporon cutaneum* at the site 15. The site 16, as the only one, revealed the presence of *Myzocytium proliferum, Pythium ultimum* and *Dctylaria brochopaga*, the site 17 – *Olpidium gregarium* and 18 – *Mycocentrospora aquatica*. Worth noting is the finding of *Rhizophydium pollinis-pini* in the river Sokołda (site 15).

In the river Płoska, 45 aquatic fungus species were found at 3 sites. Worth noting (site 19) is the finding of *Truitella setifera* (Fig. 1 D) and *Achlya diffusa* (site 20) – new species to Polish hydromycoflora.

In the river Krasna, 31 species of aquatic fungi were detected. Worth noting is the finding of *Podochytrium clavatum, Anguillospora crassa* and *Geniculospora gigantea*. *Anguillospora crassa* is new to Polish waters, the others being rare in Polish waters. As it has been already mentioned, the investigations at the site 28 were

carried out in a year's cycle at the one month's intervals. Also here, autumn months were the richest and summer months the poorest in species. In January and February a sewage fungus *Leptomitus lacteus* was found.

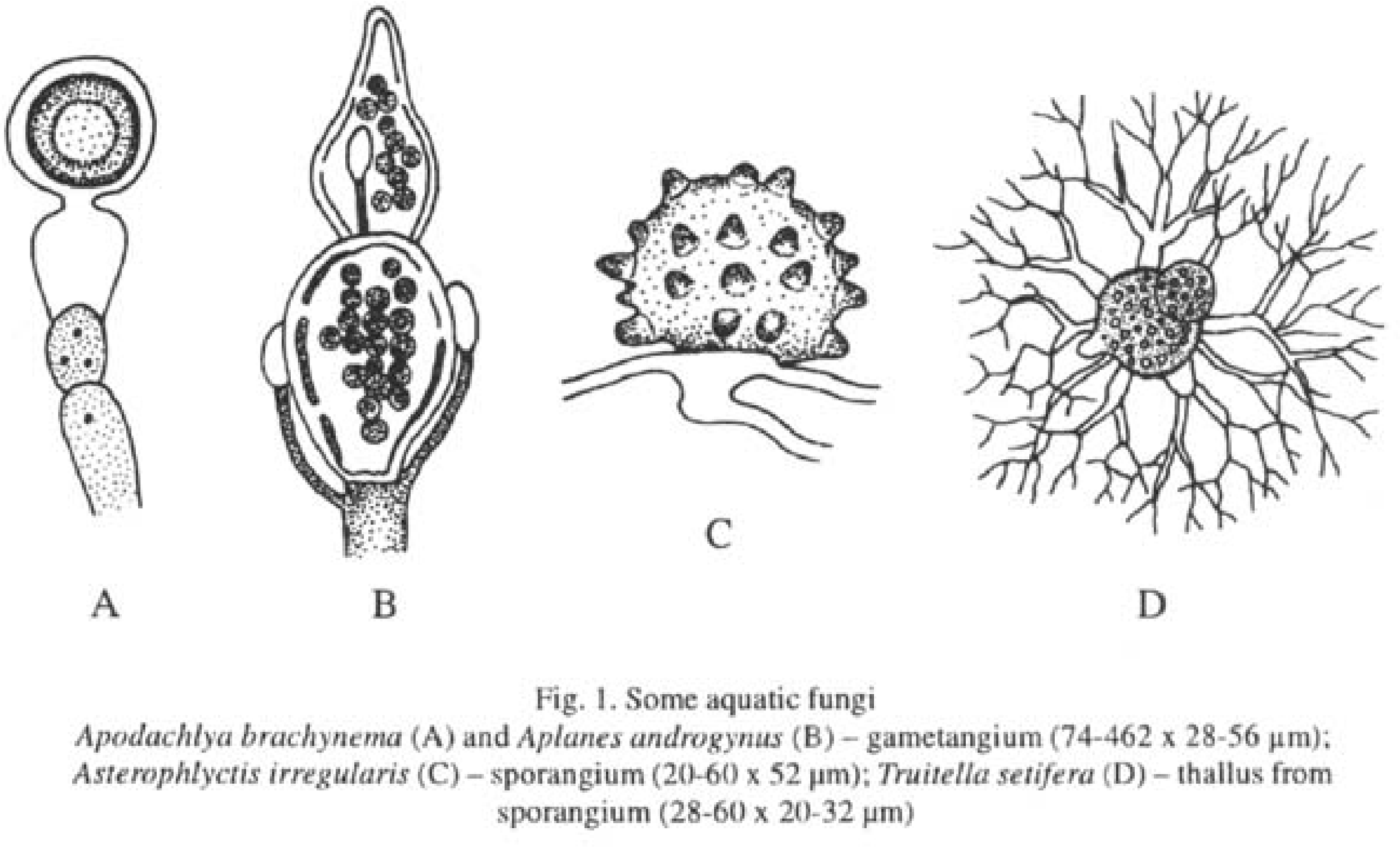

Fig. 1. Some aquatic fungi
Apodachlya brachynema (A) and *Aplanes androgynus* (B) – gametangium (74-462 x 28-56 µm); *Asterophlyctis irregularis* (C) – sporangium (20-60 x 52 µm); *Truitella setifera* (D) – thallus from sporangium (28-60 x 20-32 µm)

DISCUSSION

Mycological studies of the river Supraśl and its three tributaries revealed the presence of several rare or unknown species to the Polish hydromycoflora. Worth noting is the finding of *Karlingia rosea* and *Truitella setifera* in the river Płoska. *Karlingia rosea*, a saprophyte, can also occur as a parasite on the spores of horsetails. *Truitella setifera*, a cellulose saprophyte, is a new species to Polish waters. *Truitella setifera* was for the first time isolated by K a r l i n g (1949) from water in Maryland (USA). Two other aquatic fungus species – *Achlya diffusa* and *Apodachlya brachynema* were observed in the river Płoska as well. *Achlya diffusa* is an aquatic saprophyte, rarely found in soil, while *Apodachlya brachynema* is a chitinophylic fungus and lives in water on dead insects (C z e c z u g a, G o d l e w s k a, 1994). We observed it in the autumn at the site 20 of the river Płoska. Also noting is the finding of *Myzocytium proliferum*, one of the most common parasites of algae, *Chlorophyceae* in particular, in the river Sokołda (C z e c z u g a, W o r o n o w i c z, 1994). Two other species – *Flagellospora stricta* and *Mycocentrospora aquatica*, representatives of the *Hyphomycetes*, are also rare species. The river Supraśl is the second site of *Flagellospora stricta* and the river Sokołda is the second site of *Mycocentrospora aquatica* in Poland. *Flagellospora stricta* was first found in small watercourses in Sweden (N i l s s o n, 1962), and several years later in Armenia waters (O s i p j a n,

A j r a p e t i j a n, 1979). In Poland it was found in the water of fish ponds in Poryta Jabłoń (C z e c z u g a et al., 1988 b). The river Supraśl is the fourth site of this fungus in the world.

Mycocentrospora aquatica was first described by I q b a l (1971) in the waters of Great Britain. Some years later it was found in irrigation canals in Uzbekistan (K i r g i z b a e v a, S a h d u l l a e v a, 1977) and in the river Bladancaj in Armenia (O s i p j a n, A j r a p e t i j a n, 1979). In Poland, the growth of this fungus was observed in the spring and in the autumn 1986 in Lake Bełdany in Mazury (C z e c z u g a, 1991 c). Some literature data (G u n a s e k e r a, 1984; M a r v a n o v a, 1984) suggest that larger numbers of aquatic fungus species occur in watercourses flowing through forest region. Our studies revealed lack of such dependence.

In the investigated river section (except the river Płoska), polluted with municipal sewage, a sewage fungus *Leptomitus lacteus* was found. It was most frequently observed in late autumn and winter.

Montly investigations of River Supraśl (site 6), River Płoska (site 21) and River Krasna (site 28) showed that the highest mean number species of aquatic fungi in all river occurred in autumn, whereas the lowest in summer (Table 8). A similar phenomenon, was observed in spring Antoniuk (C z e c z u g a et al., 1989 b), forest brooks (C z e c z u g a et al., 1986 b), river Biała (C z e c z u g a et al., 1986 a) river Rudawka (C z e c z u g a, M u s z y ń s k a, 1993 a), pool (C z e c z u g a, M u s z y ń s k a, 1993 b), peathbogs (C z e c z u g a, 1993), pond (C z e c z u g a et al., 1986 c), lake Łuknajno (C z e c z u g a et al., 1990 c) and lake Śniardwy (C z e c z u g a, 1991 c). It would seem that us seasons is the result of different overlapping factor of an abiotic and biotic nature. In autumn is highest of the solid substrates and, in summer highest of the rivalry from the other plants and eating of the fungi by the aquatic animals.

A number of studies have been done to establish the environmental factor that limits the riches of mycoflora in water bodies. Certain parameters have been considered: pH (C a n t i n o, 1966; B a r l o c h e r, 1987; I n d i r a et al., 1988), temperature (S u z u k i, 1960; S u p e r k r o p p, 1984), hardness of water (B a r l o c h e r, R o s s e t, 1981; C z e c z u g a, P r ó b a, 1987; R e b e r g e r, M e s s n e r, 1987) and the content of organic matter in water (E l - D o h l o b, A l i B a r o o l 1981; K h u l b e, 1981; R a o and C h a r y, 1981; Q u i n n, 1984; C z e c z u g a et al., 1986 a; C z e c z u g a, P r ó b a, 1987). The prevailing opinion considers temperature, appropriate concentration of organic matter and hardness of water to exert a significant influence on hydromycoflora. On the basis of long lasting studies (C z e c z u g a, P r ó b a, 1987) we can assume that the number of fungus species found in a given water body is the resultant of environmental factors of a given period. Only thermal factor presents approximately the same character of oscillations every year, while other factors of the aquatic environment display change diversity. Thus, the studies of the correlation between the number of fungus species

in a given water body and the concentration of appropriate chemical factor showed that except temperature, different environmental factors were involved in respective years (C z e c z u g a, M u s z y ń s k a, 1994).

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Mikoflora rzeki Supraśl i jej dopływów

Streszczenie

Autor badał florę grzybów na różnych stanowiskach oraz główne warunki ekologiczne panujące w środowisku wodnym rzeki Supraśl i jej dopływach. Zanotował obecność rzadkich gatunków, a wśród nich *Truitella setifera*.